Worksheet 1 Logic Gates and truth tables **Answers**

Task 1

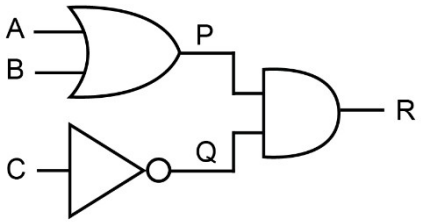
1. Write the following Boolean expressions using Boolean notation:

   (a) (A AND B) OR NOT (D AND E) $(AB)(DE)$

   (b) NOT A AND NOT (B OR C) ¬ A(BC)

   (c) (A AND B) OR (B AND (NOT C)) $(AB)(BC)$

2. (a) Complete the truth table for the following logic circuit.



(b)

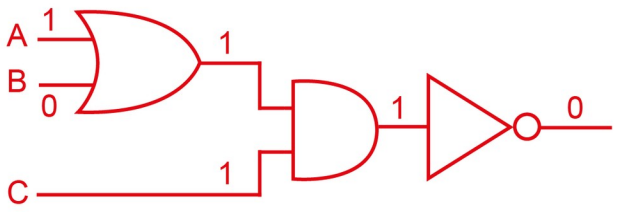
Input A	Input B	Input C	P = A ˅ B	Q = ¬C	Output R = P ˄ Q
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	0	0
1	1	0	1	1	1
1	1	1	1	0	0

Write a Boolean expression to represent this circuit in terms of A, B and C, using
Boolean notation.

(A ˅ B) ˄ ¬C

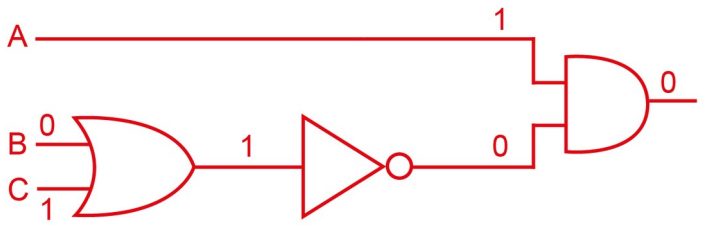
3. Draw logic circuits to represent the following Boolean expressions, and in each case say what is the output if A = 1, B = 0 and C = 1, showing the output from each gate.

   (a) Q = ¬((A ˅ B) ˄ C)



Output: 0

(b) Q = A ∧ (¬(B ∨ C))



Output: 0

Task 2

4. Draw the truth tables for the following logic circuits:

(a) A ⊻ B

Input A	Input B	Output Q
0	0	0
0	1	1
1	0	1
1	1	0

(b) (A ∧ ¬B) ∨ (¬A ∧ B)

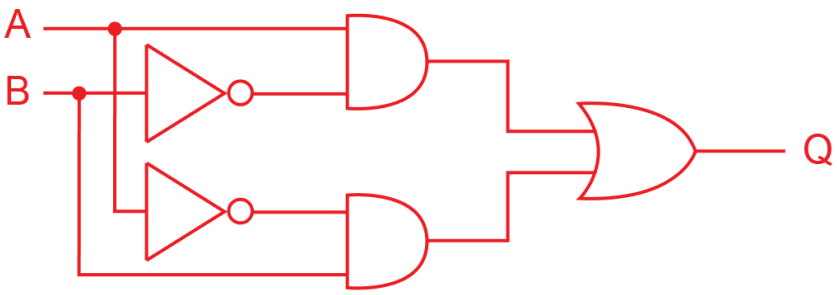
Input A	Input B	P = A ∧ ¬B	Q = ¬A ∧ B	Q = A ∨ B
0	0	0	0	0
0	1	0	1	1
1	0	1	0	1
1	1	0	0	0

What do you notice about the output in each case?

The output of A ⊻ B is the same as the output of (A ∧ ¬B) ∨ (¬A ∧ B).

This is the definition of the exclusive OR: A OR B but not both.

(c) Draw the logic circuit for the expression: Q = (A ˄ ¬B) ˅ (¬A ˄ B)



5. (a) Write the following Boolean expression using Boolean notation:

(A XOR B) AND (NOT (C XOR D))

(A ⊻ B) ˄ ¬(C ⊻ D)

(b) Draw the logic diagram using XOR, AND and OR gates, showing the output from each gate if the inputs for A, B, C and D are all 1.